Exp-Function Method for $N$-Soliton Solutions of Nonlinear Differential-Difference Equations

Sheng Zhang$^{a,b}$ and Hong-Qing Zhang$^a$

$^a$ School of Mathematical Sciences, Dalian University of Technology, Dalian 116024, P.R. China
$^b$ Department of Mathematics, Bohai University, Jinzhou 121013, P. R. China

Reprint requests to S. Z.; E-mail: dr.szhang@yahoo.com.cn

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In this paper, the exp-function method is generalized to construct $N$-soliton solutions of nonlinear differential-difference equations. With the aid of symbolic computation, we choose the Toda lattice to illustrate the validity and advantages of the generalized work. As a result, 1-soliton, 2-soliton, and 3-soliton solutions are obtained, from which the uniform formula of $N$-soliton solutions is derived. It is shown that the exp-function method may provide us with a straightforward and effective mathematical tool for generating $N$-soliton solutions of nonlinear differential-difference equations in mathematical physics.

Key words: Nonlinear Differential-Difference Equations; Exp-Function Method; $N$-Soliton Solutions.